REMARKS

Entry of this Amendment is proper because is narrows the issues on appeal and does not require further search by the Examiner.

Claims 1-2, 5, 7-9, 11 and 13-14, 17-34 and 36-44 are all the claims presently pending in the application. Claims 7-8, 13-14, 16, 18, 10, 23, 26, 31 and 34 have been withdrawn from prosecution. Claims 15-16 and 35 have been canceled. Claims 1, 28-34, 36, 38-39, 41 and 43-44 have been amended to more clearly define the invention.

It is noted that the claim amendments are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims or for any statutory requirements of patentability. Further, Applicant specifically states that no amendment to any claim herein should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claim.

Applicant respectfully notes that the Examiner did not indicate that claim 44 which was newly added by the Amendment filed on September 17, 2004, was rejected on any grounds. Therefore, claim 44 is presumably allowable. If the Examiner maintains that claim 44 is not in condition for allowance, Applicant respectfully submits that the Examiner should explain the reasons for such her rejection of the claim in another Office Action, to provide Applicant with an opportunity to respond to such rejection.

Claims 1-2, 5, 9, 11, 15, 17, 19, 21-22, 24-25, 27-30, 32-33 and 35-43 stand rejected under 35 U.S.C. § 112, second paragraph.

Claims 1-2, 5, 9, 11, 15, 17, 19, 21-22, 24-25, 27-30, 32-33 and 35-43 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Pankove (U.S. Patent No. 4,862,471), Goetz et al. (U. S. Patent No. 6,441,393), Koike et al. (U. S. Patent No. 5,945,689) and Major et al. (U. S. Patent No. 6,100,546).

This rejection is respectfully traversed in the following discussion.

I. THE CLAIMED INVENTION

The claimed invention (e.g., as recited in claim 1) is directed to a light-emitting semiconductor device including a substrate, plural semiconductor layers which are made of group III nitride group compound semiconductor formed on the substrate, and an active layer having a multiple quantum well structure.

Importantly, the multiple quantum well structure includes a plurality of quantum well layers which satisfy the formula $Al_{1-x}In_xN$, where a composition ratio x of indium (In) is in a range of where $0.15 \leq x \leq 0.6$, and at least one quantum barrier layer which satisfies the formula $Al_{1-z-y}Ga_yIn_zN$ ($0 \leq y \leq 1$, $0 \leq z < 1$, $0 \leq z+y \leq 1$), alternately formed with the plurality of quantum well layers. Further, a composition ratio y of gallium (Ga) in the at least one quantum barrier layer is one of $y=1$, $y \approx 1$, and $0.9 < y \leq 1$, and a thickness of the plurality of quantum well layers is in a range from 1nm to 10nm.

Conventional light-emitting semiconductor devices may include a quantum well structure. However, such devices often non-uniform InN compositions, so that light having colors of high purity and narrow half-width in an emission spectrum cannot be obtained (Application at [0007]). In addition, the active layers of such devices may be affected by residual stress, so that the device cannot sufficiently control the driving voltage, reducing the performance life of the device (Application at [0008]). Further, when a thin quantum well layer is laminated in a conventional device, internal stress becomes a significant problem (Application at [0009]).

The claimed device, on the other hand, includes a multiple quantum well structure having a plurality of quantum well layers which satisfy the formula $Al_{1-x}In_xN$, where a composition ratio x of indium (In) is in a range of where $0.15 \leq x \leq 0.6$ (Application at [0022] and [0061]), and a thickness of the plurality of quantum well layers is in a range from 1nm to 10nm (Application at [0017]).

As described in paragraphs [0036] to [0037] in the specification, by using AlInN and not GaInN, an In composition ratio can be increased in the same band gap (Application at Figure 3). As a result, the first problem disclosed in paragraph [0007] of the original specification can be solved.

Further, by using $Al_{1-x}In_xN$ ($0.15 \leq x \leq 0.6$), the composition ratio of In becomes large and the lattice constant becomes larger in a certain band gap (Application at Figure 3). As a result, stress in the active layer is relaxed and the second problem described in paragraph [0008] is solved (Application at [0043]).

II. THE 35 U. S. C. § 112, SECOND PARAGRAPH REJECTION

The Examiner alleges that claims 1-2, 5, 9, 11, 15, 17, 19, 21-22, 24-25, 27-30, 32-33 and 35-43 are indefinite.

Applicant would point out, however, that independent claims 1, 39 and 43 have been amended to replace the term "$0.1 \leq x < 1$" which the Examiner alleged was indefinite, with the term "$0.15 \leq x \leq 0.6$", which is clear and discussed in the present Application, for example, at paragraphs [0022] and [0061].

Therefore, the Examiner is respectfully requested to withdraw this rejection.

III. THE PANKOVE, GOETZ, KOIKE AND MAJOR REFERENCES

The Examiner alleges that Pankove would have been combined with Goetz, that the alleged Pankove/Goetz combination would have been further combined with Koike, and that the alleged Pankove/Goetz/Koike combination would have been further combined with Major to form the claimed invention of claims 1-2, 5, 9, 11, 15, 17, 19, 21-22, 24-25, 27-30, 32-33 and 35-43. Applicant submits, however, that these references would not have been combined and, even if combined, the combination would not teach or suggest each and every element of the claimed invention.

First, Applicant would respectfully point out that the Examiner is surprisingly attempting to combine four references in order to reject the claimed invention. Applicant respectfully submits that this alone establishes that the claimed invention is not obvious and that the Examiner has relied upon impermissible hindsight in attempting to reject the claims of the present Application, and thus, the Examiner has failed to establish a prima facie case of obviousness.

Further, Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, these references are directed to completely different problems and objectives. Thus, no person of ordinary skill in the art would have considered combining the references as alleged by the Examiner, absent impermissible hindsight.

Further, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination as alleged by the Examiner. Indeed, nowhere do the references teach or suggest such a combination as alleged by the Examiner. Thus, the Examiner has clearly failed to make a prima facie case of obviousness.

The Examiner again surprisingly fails to identify any passage in any of these references to support her allegation that the references would have been combined. To support her allegation, the Examiner states only "*See reasons of record. As noted in the Office action of 17 June 2004, the MQW structure is taught in the first three references, and all of the references address the specific class of materials recited*" (Office Action at page 3). However, nowhere in the 17 June Office Action did the Examiner identify any passage in the references to support her allegations that the references would have been combined.

Moreover, Applicant respectfully points out that MPEP §2142 states that to establish a prima facie case of obviousness, **the Examiner must identify some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Further, the teaching or suggestion to make the claimed combination must be found in the prior art, and not based on applicant's disclosure** (MPEP §2142 citing In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991) (emphasis added).

In this case, the Examiner has never identified any suggestion or motivation to combine the reference teachings in the references. In fact, the Examiner has never even alleged that a suggestion or motivation to combine the reference teachings was in the knowledge generally available to one of ordinary skill in the art at the time of the invention.

In fact, the Examiner merely states that "all of the references address the specific class of materials recited". **Applicant submits that this vague generalization says nothing about "suggestion or motivation to combine" and is clearly not enough to comply with the Examiner's requirements under MPEP §2142.**

Indeed, Applicant points out that there may be hundreds of references that address light-emitting devices having an active layer with a multiple quantum layer structure with a specific class of materials. Using the Examiner's erroneous logic, all of these references could be combined into one "uber reference" in order to reject every claim ever presented, by the mere fact that the references address similar subject matter. Clearly, the Examiner is incorrect.

Thus, Applicant respectfully submits that the Examiner has failed to establish a prima facie case of obviousness, and should withdraw this rejection.

Moreover, Applicant submits that neither Pankove, nor Goetz, nor Koike, nor Major,

nor any combination thereof teaches or suggests a multiple quantum well structure having a plurality of quantum well layers which satisfy the formula $Al_{1-x}In_xN$, where a composition ratio x of indium (In) is in a range of where $0.15 \leq x \leq 0.6$ (Application at [0022] and [0061]), and a thickness of the plurality of quantum well layers is in a range from 1nm to 10nm (Application at [0017]).

As noted above, by using AlInN and not GaInN, an In composition ratio can be increased in the same band gap (Application at Figure 3). Further, by using $Al_{1-x}In_xN$ ($0.15 \leq x \leq 0.6$), the composition ratio of In becomes large and the lattice constant becomes larger in a certain band gap, such that stress in the active layer is relaxed (Application at Figure 3; paragraph [0043]).

Clearly, these features are not taught or suggested by the cited references. Indeed, nowhere do these references teach or suggest a thickness of a plurality of quantum well layers in a range from 1nm to 10nm. In fact, the Examiner does not even allege that this feature is taught or suggested by references, but merely alleges (on page 3 of the 17 June Office Action) that "it would have been obvious to choose layer thicknesses... in order to optimize crystal quality due to lattice mismatch, for example, and to acquire desired carrier confinement".

Applicant submits, however, nowhere do the references teach or suggest optimizing a thickness of the quantum well layers to provide the desirable **results that can be provided by the claimed invention.** Therefore, the Examiner's allegation that the references somehow show that the claimed thickness has no patentable significance, is clearly not reasonable.

Moreover, Applicant points out that the MPEP provides that "[a] particular parameter must first be recognized as a result-effective variable, i.e., **a variable which achieves a recognized result**, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation" (MPEP at §2144.05) (emphasis added). Here, the references do not teach or suggest optimizing the thickness of the plurality of quantum well layers to provide the results of the claimed invention. Therefore, it is clearly unreasonable to suggest that these references teach or suggest that a thickness of a plurality of quantum well layers is merely a result-effective variable.

Further, none of the cited references teach or suggest a quantum well layer having $Al_{1-x}In_xN$ ($0.15 \leq x \leq 0.6$). For example, Goetz may disclose that AlInN can be generally used for a material of a MQW layer. However, Goetz fails to teach or suggest that $Al_{1-x}In_xN$

($0.15 \leq x \leq 0.6$) can be especially used for a quantum well layer of an active layer having a MQW structure for the purpose of uniformly dispersing In in the well layer.

Indeed, the Examiner essentially concedes that this feature is not taught or suggested by Pankove, Goetz or Koike, but alleges that the feature is taught by Major. The Examiner is clearly incorrect.

In the claimed invention, an In composition ratio x in the AlInN well layer is in a range from 0.15 to 0.6. Thus, the Al composition ratio in the well layer should be in a range from 0.4 to 0.85. That is, in the well layer of the claimed invention, Al is an important (e.g., essential) component. Thus, the claimed invention is unrelated to a device in which Al is not intentionally a component, or in which Al is mixed into the well layer by diffusion of an adjacent layer or the Al electrode. Thus, the Examiner cannot rely on such possibilities to reject the claimed invention.

Moreover, the in the claimed invention, the well layer has thickness from 1nm to 10nm. Nowhere is this combination of features taught or suggested by the cited references. That is, none of the cited references teach or suggest an active layer having an MQW structure which comprises the $Al_{1-x}In_xN$ ($0.15 \leq x \leq 0.6$) well layer having thickness from 1nm to 10nm (e.g., and $Al_{1-z-y}Ga_yIn_xN$ ($0.9 \leq y \leq 1$) barrier layer).

In the present invention, a well layer of an active layer having MQW structure includes $Al_{1-x}In_xN$ having a large indium concentration ($0.15 \leq x \leq 0.6$), to thereby solve problems 1-3 described paragraphs [007] to [009] in the original specification.

Especially, as shown in the Figure 2 of the Application and in paragraphs [0034] to [0035] in the specification, when a composition ratio of In is enlarged, it is understood that the deviation of composition ratio of In hardly becomes unstable. And as described in paragraphs [0036] to [0037] in the specification, an In composition ratio can be increased in the same band gap by using AlInN and not GaInN (Application at Figure 3).

As a result, the first problem disclosed in paragraph [0007] of the original specification can be solved. By using $Al_{1-x}In_xN$ ($0.15 \leq x \leq 0.6$), a composition ratio of In becomes large and lattice constant becomes larger in a certain band gap (Application at Figure 3). As a result, stress in the active layer is relaxed and the second problem described in paragraph [0008] is solved (paragraph [0043]).

Accordingly, by using $Al_{1-x}In_xN$ ($0.15 \leq x \leq 0.6$) having a thickness in a range from 1nm

to 10nm to form the well layer of the active layer, characteristics of the light-emitting device can be remarkably improved. This is clearly not taught or suggested by the cited references. In short, no prior art teaches to use $Al_{1-x}In_xN$ ($0.15 \leq x \leq 0.6$)/$Al_{1-z-y}Ga_yIn_xN$ ($0.9 \leq y \leq 1$) to form the MQW in the active layer.

Similarly, Major does not teach or suggest the features of the claimed invention. Indeed, as noted above, Major merely teaches a III-V arsenide-nitride semiconductor device in which group III elements are combined with group V elements, in concentrations chosen to lattice match commercially available crystalline substrates (Major at Abstract).

In fact, like Pankove, Goetz and Koike, Major does not even recognize the importance of having both Al and In (e.g., in the form of AlInN) in a quantum well layer. Thus, Major clearly does not make up for the deficiencies of the alleged Pankove/Goetz/Koike combination.

The Examiner again attempts to rely on Figure 2 in Major to support her position. However, as Applicant pointed out in the Amendment filed on September 17, 2004, Figure 2 in Major is **merely a graph plotting the bandgap and lattice constant** of AlGaInN wurtzite crystals superimposed with the lattice constant of some common substrates (Major at col. 6, lines 17-19). Figure 2 may be used, for example, to select a substrate on which to form certain compounds, based on a lattice matching.

However, Figure 2 in Major does not teach or suggest a multiple quantum well structure having a plurality of quantum well layers which satisfy the formula $Al_{1-x}In_xN$, where a composition ratio x of indium (In) is in a range of where $0.15 \leq x \leq 0.6$, and a thickness of the plurality of quantum well layers is in a range from 1nm to 10nm. Indeed, Figure 2 says nothing about a multiple quantum well structure of an active layer and is completely unrelated to such a structure.

Further, the Examiner surprisingly states that Figure 2 in Major "teaches the entire range of x, from zero to 1". Clearly, Figure 2 in Major teaches no such thing.

In fact, Figure 2 merely illustrates a plot of bandgap vs. lattice constant of AlGaInN. However, nowhere does this plot recognize any preferable amount of Al, Ga or In in a quantum well layer.

Therefore, contrary to the Examiner's allegations, Major does not make up for the deficiencies of the alleged Pankove/Goetz/Koike combination.

Therefore, Applicant submits that these references would not have been combined, and even if combined, the combination would not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

III. FORMAL MATTERS AND CONCLUSION

In view of the foregoing, Applicant submits that claims 1-2, 5, 9, 11, 17, 19, 21-22, 24-25, 27-30, 32-33 and 36-44, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

Date: 2/24/05

Phillip E. Miller, Esq.
Registration No. 46,060

McGinn & Gibb, PLLC
8321 Old Courthouse Road, Suite 200
Vienna, VA 22182-3817
(703) 761-4100
Customer No. 21254

CERTIFICATE OF FACSIMILE TRANSMISSION

I hereby certify that the foregoing was filed by facsimile with the United States Patent and Trademark Office, Examiner Sara Crane, Group Art Unit # 2811 at fax number (703) 872-9306 this 24th day of February, 2005.

Phillip E. Miller
Reg. No. 46,060